

AD A1309505

12

Research Product 82-5

Stabilized Gunnery Training
Techniques

ARI Field Unit at Fort Knox, Kentucky

February 1982

DTIC FILE COPY



DISTRIBUTION STATEMENT A
Approved for public release
Distribution Unlimited

DTIC
ELECTE
S AUG 2 1983 D
D

U.S. ARMY RESEARCH INSTITUTE for the BEHAVIORAL and SOCIAL SCIENCES

83 08 01 008

U. S. ARMY RESEARCH INSTITUTE FOR THE BEHAVIORAL AND SOCIAL SCIENCES

A Field Operating Agency under the Jurisdiction of the
Deputy Chief of Staff for Personnel

JOSEPH ZEIDNER
Technical Director

L. NEALE COSBY
Colonel, IN
Commander

Research accomplished under contract
to the Department of the Army

Human Resources Research Organization

NOTICES

FINAL DISPOSITION: This Research Product may be destroyed when it is no longer needed. Please do not return it to the U.S. Army Research Institute for the Behavioral and Social Sciences.

NOTE: This Research Product is not to be construed as an official Department of the Army document in its present form.

UNCLASSIFIED

SECURITY CLASSIFICATION OF THIS PAGE (When Data Entered)

| REPORT DOCUMENTATION PAGE | | READ INSTRUCTIONS BEFORE COMPLETING FORM |
|---|--|---|
| 1. REPORT NUMBER Research Product 82-5 | 2. GOVT ACCESSION NO. AD 111367107 | 3. RECIPIENT'S CATALOG NUMBER |
| 4. TITLE (and Subtitle) Stabilized Gunnery Training Techniques | 5. TYPE OF REPORT & PERIOD COVERED Research Product | |
| 7. AUTHOR(s) James H. Harris Human Resources Research Organization and Stephen L. Goldberg and John E. Morrison U.S. Army Research Institute | 6. PERFORMING ORG. REPORT NUMBER RP-MTRD(KY)-82-2 | |
| 8. PERFORMING ORGANIZATION NAME AND ADDRESS Human Resources Research Organization 301 North Washington Street Alexandria, Virginia 22314 | 9. CONTRACT OR GRANT NUMBER(s) Contract No. MDA 903-80-C-0529 | |
| 11. CONTROLLING OFFICE NAME AND ADDRESS U.S. Army Research Institute for the Behavioral and Social Sciences 5001 Eisenhower Avenue, Alexandria, Virginia 22333 | 10. PROGRAM ELEMENT, PROJECT, TASK AREA & WORK UNIT NUMBERS 6.37.43A 2Q263743A794 | |
| 14. MONITORING AGENCY NAME & ADDRESS (if different from Controlling Office) | 12. REPORT DATE February 1982 | |
| | 13. NUMBER OF PAGES 38 | |
| | 15. SECURITY CLASS. (of this report) UNCLASSIFIED | |
| | 15a. DECLASSIFICATION/DOWNGRADING SCHEDULE | |
| 16. DISTRIBUTION STATEMENT (of this Report) | | |
| <div style="border: 1px solid black; padding: 5px; text-align: center;"> DISTRIBUTION STATEMENT Approved for public release; Distribution Unlimited </div> | | |
| 17. DISTRIBUTION STATEMENT (of the abstract entered in Block 20, if different from Report) | | |
| Approved for open release; distribution unlimited. | | |
| 18. SUPPLEMENTARY NOTES Research performed by HumRRO, Fort Knox Office, P.O. Box 293, Fort Knox, Kentucky 40121, and technically monitored by Robert W. Bauer of the ARI Field Unit at Fort Knox. | | |
| 19. KEY WORDS (Continue on reverse side if necessary and identify by block number) | | |
| Armor | Armor training | |
| Tanks | Stabilized gunnery training | |
| Tank gunnery | Moving platform gunnery training | |
| 20. ABSTRACT (Continue on reverse side if necessary and identify by block number) | | |
| <p>✓ A training program to provide elementary skill in M60A3 stabilized gunnery was developed. The program, centered around 14 analytically-derived principles of stabilized gunnery, is in three parts. The first, a knowledge videotape, familiarizes soldiers with "patterns" of reticle movement and demonstrates the correct point in the "pattern" to lose and fire. The second product, a practice videotape, when used with a mock-up of the Gunner's periscope and control, handles, provides practice in "anticipating" the reticle movement, as well as in</p> | | |

DD FORM 1 JAN 73 1-73

EDITION OF 1 NOV 65 IS OBSOLETE

1

UNCLASSIFIED

SECURITY CLASSIFICATION OF THIS PAGE (When Data Entered)

UNCLASSIFIED

SECURITY CLASSIFICATION OF THIS PAGE (When Data Entered)

lasing and firing. The third product, a series of tank stabilized gunnery exercises, allows soldiers to practice on M60A3 tanks some of the things presented in the knowledge videotape and practice using the practice tape device.

The three products of the training program development appear to be useful at the OSUT level. The knowledge videotape can be group administered using equipment available in any OSUT battalion. The gunner response device is relatively inexpensive to produce and can be set up in a dayroom or corner of a classroom. The M60A3 tank stabilized exercises can be practiced anytime a soldier is in the Gunner's seat and the tank is moving, say from the motor pool to the firing range or driving course.

A description of the development and evaluation of the training products is presented in the final report for the project (Harris et al., 1982).

| | |
|---------------|-------------------------------------|
| Accession For | |
| NTIS GRA&I | <input checked="" type="checkbox"/> |
| DTIC TAB | <input type="checkbox"/> |
| Unannounced | <input type="checkbox"/> |
| Justification | |
| By _____ | |
| Distribution/ | |
| Avail and/or | |
| Dist | Special |
| A | |

Research Product 82-5

STABILIZED GUNNERY TRAINING
TECHNIQUES

James H. Harris

Human Resources Research Organization

and

Stephen L. Goldberg
John E. Morrison

U.S. Army Research Institute for the
Behavioral and Social Sciences

Submitted by:

Donald F. Haggard, Chief
A.R.I. Field Unit at Fort Knox, KY

Approved by:

Milton S. Katz, Acting Director
Training Research Laboratory

U.S. ARMY RESEARCH INSTITUTE FOR THE BEHAVIORAL AND SOCIAL SCIENCES
5001 Eisenhower Avenue, Alexandria, VA 22333

Office, Deputy Chief of Staff for Personnel
Department of the Army

February 1982

Army Project Number
2Q263743A794

Education and
Training

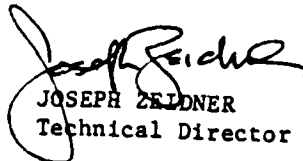
Approved for public release; distribution unlimited

FOREWORD

The Fort Knox Field Unit has a continuing research program on performance problems associated with the Army's new advanced armor systems. The Weapon System Training Team is specifically focused on training solutions to those problems.

Due to advanced stabilization systems, modern main battle tanks can be fired while on the move. To realize the full capabilities of these armor systems, tank gunnerys must be taught how to fire from a moving platform. However, live-fire exercises are prohibitively expensive in terms of fuel and ammunition costs. This research product presents a program designed to train stabilized gunnery skills without requiring live-fire exercises.

The present products are designed to be incorporated within the Armor OSUT M60A3 program. However, the training approach also has applications to unit training and training on other stabilized tanks (i.e., the M60A1 AOS and the M1).


JOSEPH ZELDNER
Technical Director

PRECEDING PAGE BLANK-NOT FILLED

PREFACE

This is an interim report on one task of Part II of a two part project: "Research on Armor Weapon System Employment Parameters: Small Crew Performance Estimates and Moving Platform Stabilized Gunnery Training Techniques," ARI Contract Nr. MDA 903-80-C-0529. Part II concerns gunnery training techniques for moving platform gunnery, the specific objectives of which are to design, develop, and pilot test moving platform gunnery techniques. The task from Part II reported here is: Task 7, Program Development. The material presented in this report is presented in its entirety in Final Report MTRD (KY) - 82-1 (Harris, Melching, Morrison, and Goldberg, 1982).

The videotapes referenced in this report can be obtained through the Training and Audiovisual Support Center, ATTN: ATZK-DPT-TASC, Fort Knox, KY 40121. The Knowledge Tape (FK-57-81) is entitled "M60A3 Stabilized Gunnery"; the title for the Practice Tape (FK-58-81) is "M60A3 Stabilized Gunnery: Lasing and Firing Exercises."

The authors would like to acknowledge the important roles that other people played in executing this research project:

- Mr. Merlin Allen who designed and built the practice tape device.
- SFC Michael Gunoung who provided substantial input to the determination of the program content and supervised the preparation of the videotapes at Wilcox Range.
- SFC Patrick K. Pursifull who provided considerable support and expertise during the preparation of the final videotapes.
- Mr. Irv Kimmel and staff of the Optical Instrumentation Branch, Armor Engineer Board, for preparing the videotapes at Wilcox Range.
- Mr. Robert Grimes, Mr. Harry Wilson, and staff of the Fort Knox television studio, for preparing the final videotapes.

STABILIZED GUNNERY TRAINING TECHNIQUES

EXECUTIVE SUMMARY

Requirement:

To develop a stabilized gunnery training program for the M60A3 tank for use in Armor One Station Unit Training (OSUT).

Procedure:

The training program content was derived from literature on stabilized gunnery, interviews of subject matter experts, and a hands-on orientation to M60A3 stabilized gunnery. The program material consisted of three products: (1) a videotape for presenting information on stabilized gunnery, (2) an inexpensive training device for practicing the timing skills of stabilized gunnery, and (3) hands-on exercises for practicing skills learned from the videotape and training device on actual M60A3 equipment.

Findings:

The training products appear to be useful for training stabilized gunnery skills at the OSUT level.

Utilization:

The videotape can be group-administered using equipment available in any OSUT battalion. The inexpensive training device can be set up in a dayroom or corner of a classroom. The M60A3 tank stabilized exercises can be practiced anytime a soldier is in the Gunner's seat and the tank is moving, say from the motorpool to the firing range or the driving course.

TABLE OF CONTENTS

| | Page |
|--|------|
| INTRODUCTION | 1 |
| DETERMINE PROGRAM CONTENT | 2 |
| Literature Review | 2 |
| M60A3 Orientation | 3 |
| SME Interviews | 3 |
| DEVELOP TRAINING MATERIALS | 7 |
| Videotape Preparation | 7 |
| Knowledge Videotape | 7 |
| Practice Videotape | 10 |
| M60A3 Exercise Preparation | 10 |
| SUMMARY | 12 |
| REFERENCES | 13 |
| APPENDIX A ADDITIONAL BIBLIOGRAPHIC ANNOTATIONS ON STABILIZED GUNNERY | 15 |
| B SCRIPT FOR MOVING PLATFORM GUNNERY KNOWLEDGE VIDEOTAPE | 19 |
| C M60A3 TANK STABILIZED GUNNERY EXERCISES | 30 |

LIST OF TABLES

| | |
|---|---|
| Table 1. Situations For Knowledge Videotape | 9 |
|---|---|

PRECEDING PAGE BLANK-NOT FILLED

DEVELOPMENT OF A STABILIZED GUNNERY TRAINING PROGRAM

INTRODUCTION

Advances in stabilized optics and fire control systems and requirements for a moving gun platform for Armor have resulted in the development of three battle tanks which can be fired on-the-move; the M60A1AOS, the M60A3, and the M1. Doctrine developed for Armor employment stresses this shoot-on-the-move capability. Battlefield tactics written for the ground combined arms force of the M1 tank, M2 infantry fighting vehicle and M3 cavalry fighting vehicle employ shoot-on-the move techniques in all situations except the static defense and for very long range precision gunnery where the firing vehicle is beyond the range of the threat vehicle. There is some evidence that the shoot-on-the-move capability of stabilized tanks is not being used as intended. As Ogorkiewicz (1976) points out:

" . . . there has been continued scepticism about the claims that the existing systems enable tanks to fire on the move, if this implies firing with anything like the accuracy possible at the halt. In fact, it is usually conceded that the main benefit to be derived from the existing stabilization systems is . . . to acquire targets on the move and to lay the gun so that a minimum of fine adjustment and time is required when the tank comes to a short halt to fire with the high accuracy of which it is then capable."

He goes on to suggest that "more elaborate stabilization systems than those based on two rate gyros mounted in the turret" may enable tank crews to come closer to the desired objective of firing on the move with a high hit probability.

The introduction of stabilization requires the development of specific training for operators of stabilized gun systems--training that differs in various respects from training for stationary gunnery. This report documents the development and tryout of a program focusing on such training for M60A3 stabilized gunnery in one station unit training (OSUT) and describes three research products. The M60A3 tank was chosen over the M60A1AOS because it has the more sophisticated stabilization system and more closely resembles the fire control system on the M1 which had not entered the OSUT inventory when the project began. The work is described in three phases: (1) Determine program content, (2) develop training material, and (3) tryout materials.

DETERMINE PROGRAM CONTENT

The development of effective training proceeds from a base of familiarity with the subject material. To enhance staff familiarity with the M60A3 tank system three activities were undertaken. The three activities were:

1. Literature review.
2. M60A3 orientation.
3. Subject matter expert (SME) interviews.

These activities occurred simultaneously and information gathered during one activity often clarified the scope of another. When the reviews, orientation, and interviews were completed, the content and focus of the program was determined.

Literature Review

In an earlier report (Author, 1981) a literature review was conducted to collect information on training strategies for moving platform stabilized gunnery. Behavioral implications or aspects of stabilization and its effect on training techniques were also considered. The articles examined covered the mechanics of stabilization, helicopter gunnery, trends in tank technology and Soviet training techniques. The literature, however, did not provide specific information about stabilized gunnery training. Six additional articles were reviewed since the earlier report was published (see Appendix A). These six articles covered aerial gunnery, the aerial training device 3-A-2, and gunnery training for tank crews. They provided no specific information about stabilized gunnery training.

A review of relevant field manuals (U.S. Army, 1977) and technical manuals (U.S. Army 1979) indicated two principles that must be followed when firing on the move:

1. Treat each round as a separate engagement. When firing on the move, particularly against moving targets, the rapidly changing tank-to-target relationship makes BOT difficult, if not impossible, to use.
2. Fire only when the gun tube is over the front or rear fenders. The smaller the acute angle between the gun and the line of travel, the better the stabilization. Therefore, fire over the flank only as a last resort.

M60A3 Orientation

After reviewing the "arrangement" of both the Gunner and Tank Commander stations, to include the operation of the fire control system, dry fire target engagements were run at various speeds over progressively rougher terrain. In addition to clarifying the mechanics and operation of stabilization on an M60A3, the orientation clarified vividly the major difference between firing from a stationary tank and firing from a moving tank.

The tank stabilization system of the M60A3 tank is designed to keep the gun tube and sights at the same elevation and direction regardless of the up-and-down or side-to-side movement of the tank. Thus, stabilization aids the gunner in keeping the reticle on target. Nevertheless, there are "error" inputs into this man-machine system which tend to draw the target off the reticle cross hairs, inducing apparent reticle movement with respect to target scene. A primary source of error input, common to moving platform and stationary gunnery, is movement of target relative to firing tank. The critical difference between the two gunnery modes is that, in moving platform gunnery, apparent reticle movement can also be caused by movement of the firing tank. Fortunately, these error sources are somewhat predictable and can be corrected by adjustments in tracking.

Two other error inputs are caused by limitations of the stabilization system itself. The first error source is due to tank movements too large or too fast for the stabilization system to compensate. The second is caused by the linkage of the gun and the sight: If the linkage has some play in it, the sights will appear to jiggle.¹ These errors also induce apparent reticle movement. However, both errors are too fast and unpredictable to be corrected by tracking adjustments. Experienced M60A3 gunners report that to overcome the seemingly random sight movement, the gunner must be able to time his shot because the cross hairs are on the target only momentarily; that is, he must anticipate when the target will approach the center of the reticle and lase and fire prior to its reaching that point. This timing skill is a gunnery component peculiar to firing on the move.

SME Interviews

The interviews with SME were conducted informally, either individually or in groups of four to five soldiers. Their experience in terms of M60A3 tank rounds fired on-the-move ranged from only dry-fire exercises on the tank up to one NCO who fired "3500-4000 rounds." In all, 14 soldiers were interviewed. Generally, the interviews were open-ended

¹Discussions with TRADOC Systems Manager (TSM) personnel indicated that much of the "sight jiggle" in early production M60A3 tanks was due to a faulty gun/sight linkage. Mechanical improvements to the older sights have minimized the problem, however.

with the soldier's response to a particular question leading naturally to other questions. Some of the information gathered from these interview sessions proved useful during the development phase of the project. Following are the questions whose answers helped determine the program content:

1. When firing the M60A3, what is harder about firing from a moving platform (at least the first few times) than firing from a stationary platform?

Answers:

- a. Timing "pattern"¹ about the target.
- b. Changes in speed of apparent reticle movement when firing tank changes speed.
- c. "Jitter" in the sight.

2. What do you do to compensate?

Answers:

- a. Time shot. This timing, or anticipating, skill is a gunnery component peculiar to firing on the move.
- b. Learn to recognize drift patterns and fire on first return to target.
- c. Ambush the target.
- d. Fire lots of rounds.
- e. Let stabilization system operate around target area; Gunner just track target.
- f. Know speed at which stabilization system smooths out.

3. How do you sit in the Gunner's seat when firing from a moving platform?

Answers:

- a. Brace self and take-up same sight picture.
- b. Press head harder on head rest.
- c. Remain rigid but relaxed; roll with the punches.
- d. Rigid but braced feet, head, and hands.
- e. Firm head rest--press down firmer in seat--place feet flat and centered below Gunner's control handles.

¹These "patterns" are the seemingly random reticle movements caused by the three types of error inputs inherent in moving platform gunnery.

- f. As speed increases and terrain gets rougher, keep body rigid from waist up to keep head in brow pad.
- 4. Can burst-on-target and subsequent fire command still be used to adjust fire when the M60A3 is moving?
Answer:
 - a. No, because tank movement causes left-right relationship of target and burst to be distorted.

Information gathered from the orientation, interviews, and reviews was consolidated and the following principles of firing on the move emerged:

1. Treat each round as a separate engagement.
2. Know the "sweet spot" for your tank.¹
3. Know reticle drift pattern for your tank.
4. Anticipate "pattern" of reticle movement.
5. Anticipate movement of tank.
6. Fire between front or rear fenders.
7. Fire over flank only as last resort.
8. Press head into browpad, back against seat back.
9. Allow stabilization system to do its work.
10. Lose and lead with either thumb switch.
11. Know that when turret is in STAB mode, don't have to squeeze palm switches to traverse or elevate and depress turret.
12. Know there is no such thing as a "perfect" sight picture.
13. Know that main gun, within limits, maintains fixed orientation in space regardless of vehicle motion.
14. Take up same sight picture.

¹The "sweet spot" speed is the speed where the apparent reticle movement is minimal. The sweet spot differs for each tank depending on such factors as terrain type.

The development of a training program centered around these principles was undertaken. But since the program was to be used during the conduct of fire phase of M60A3 OSUT, certain constraints had to be considered: The relative inexperience of the soldiers; the limits on available time; and, a scarcity of tanks, main gun ammunition, gasoline, and ranges suitable for moving tank gunnery. Thus both the analytically derived gunnery principles and the prevailing program constraints guided the design of training materials.

DEVELOP TRAINING MATERIALS

The developmental approach to training was straightforward: provide performance-oriented instructional events in which the soldier could acquire, (a) knowledge of the relevant stabilized gunnery principles and (b) skill in their application. Too, the approach called for a training medium that was inexpensive yet permitted a level of visual realism sufficient to display realistic stabilized reticle movement in relation to recognizable targets. A video display linked to a simple response mechanism met these requirements.

Tank targets at various speeds and ranges were filmed through the stabilized sight of an M60A3 moving tank. Films of these targets were sorted out on the basis of clarity and demonstration of the stabilized gunnery principles; then, arranged in terms of engagement difficulty. Two videotapes, one for training knowledge of stabilized gunnery principles, the other for practicing those principles were prepared. After the videotapes were prepared, a series of exercises was developed to enable soldiers to practice on M60A3 tanks what they had learned on the videotapes. The exercises are designed to be used anytime the soldier is in the Gunner's seat and the tank is moving.

Videotape Preparation

Two videotapes were prepared. The first, a knowledge videotape (KT), presents the firing on the move principles in terms of their knowledge components. The second, a practice videotape (PT), when coupled with a simple response device enables practice of some skill components of the firing on the move principles. In general, the videotapes are to be used during training to:

1. Familiarize soldiers with the "patterns" of reticle movement about the aim point during stabilized gunnery engagements. (KT)
2. Demonstrate the correct point in the "pattern" to lase and fire. (KT)
3. Provide practice in "anticipating" the reticle movement about the aim point during stabilized gunnery engagements. (PT)
4. Provide practice in lasing and firing. (PT)

Knowledge Videotape

Twelve situations are presented in increasing order of engagement difficulty. Engagement difficulty is presumed to increase as range to target increases and firing tank speed, target speed, or both increase.

The M60A3 orientation focused the scope of the training content on target engagements where the firing tank is traveling at speeds of 10 MPH or less, the target tank is stationary or traveling at 10 MPH, and the firing tank-to-target range is 1600 meters or less. The 12 situations are presented in tabular form in Table 1. Situations 3, 6, and 8 are split screen presentations of Situations 1/2, 4/5, and 5/7, respectively. This permits soldiers to compare and contrast sight picture differences when range differs (Situation 3); when terrain and range differ (Situation 6) and when firing tank speed differs (Situation 8). Situation 12 is an example of how the reticle vibration tends to "smooth out" at certain speeds. The 12 situations are followed by five new situations in which the correct lase and fire points during the reticle movement are demonstrated. In addition, on the last two situations, the correct technique for adjusting fire is discussed and demonstrated. Narration describing the firing on the move principles as they are presented is provided throughout the videotape.

The principles presented on the videotape are:

- Three contact points
 - Press head firmly against browpad.
 - Press lower back against Gunner's seat backrest.
 - Place feet flat on turret floor.
- Reticle movement
 - Movement caused by stabilization system.
 - Influenced by speed of tank and type of terrain.
 - The speed where vibration in sight picture smooths out and reticle jumps around less is the "sweet spot."
- Tracking
 - Let stabilization system make fine corrections around the target area.
 - Use Gunner's control handles to track the target.
- Front deck
 - Lase and fire only when gun tube is over the front deck, unless . . .
 - You encounter a surprise target on your flank.
- Lase and fire
 - Anticipate reticle movement toward center of mass.
 - Lase and fire immediately when it moves toward center of mass.
 - Depress and hold either palm switch.
 - Track for at least 1-1/2 seconds.
 - Depress and release either Gunner's thumb switch.

Table 1
Situations For Knowledge Videotape

| SITUATION | FIRING TANK | | TARGET | | |
|-----------|----------------|---------|----------------|---------------------------------|-------------------|
| | Speed (MPH) | Terrain | Speed (MPH) | Direction | Range (Meters) |
| 1 | 5 | Smooth | Stationary | Facing | 1400M |
| 2 | 5 | Smooth | Stationary | Facing | 1600M |
| 3-1/2 | 5 | Smooth | Stationary | Facing | 1400/1600M |
| 4 | 5 | Smooth | 10 | Right to Left | 1600M |
| 5 | 5 | Rough | 10 | Left to Right | 1000-500M |
| 6-4/5 | 5 | S/R | 10 | Right to Left/ Left to Right | 16M/10-5M |
| 7 | 10 | Rough | 10 | Right to Left | 1000-500M |
| 8-5/7 | 5/10 | Rough | 10 | Left to Right/ Right to Left | 1000-500M |
| 9 | 5 | Rough | 10 | Right to Left | 1200-500M |
| 10 | 10 | Rough | 10 | Advancing | 1000-500M |
| 11 | 5-7 | Rough | 10 | Retreating | 700-500M |
| 12 | 20 | Smooth | Stationary | Side | 1100M |

- Adjust fire
 - Reengage technique to adjust fire.
 - Release and then depress Gunner's palm switch.
 - Track target.
 - Release.
 - Fire a second round.

The script for the moving platform gunnery knowledge videotape is presented at Appendix B.

Practice Videotape

The practice videotape presents 18 situations of 20 seconds each. The first nine situations are presented in increasing order of difficulty; then, the same nine situations are presented in random order. The videotape is to be used with a very simple mechanical response device called the Practice Tape Device (PTD) which includes a set of M60A3 Gunner handles and periscope. The Gunner handles are not responsive; the device provides practice only on timing (anticipating) not tracking. The device is designed so that the soldier observes the video display through the periscope and lases and fires when he thinks the sight picture is correct for lasing and firing. When the soldier thinks the sight picture is correct for lasing, he presses either Gunner's thumb switch to set lead and fire the laser. The videotape "freezes" and the accuracy of his response, in terms of deflection (left or right) and elevation (short or over), as well as the time to respond can be recorded and evaluated. The device is reactivated after the lasing response is recorded and the soldier presses either firing trigger when the sight picture is correct for firing. Again, the videotape "freezes" and the accuracy of his response as well as the time to respond can be recorded and evaluated.

M60A3 Exercise Preparation

A series of five exercises was developed to enable soldiers to practice on M60A3 tanks some of the things presented in the knowledge videotape and practiced using the device and practice videotape. The exercises comprise the essential requirements for acquiring proficiency in moving platform gunnery on the M60A3 tank. They should be practiced whenever possible. The practice can be done formally, during scheduled training time, or informally, whenever the tank is moving and the soldier is in the Gunner's position.

Exercises were developed to include:

Exercise 1: Taking up the correct position in the Gunner's seat.

Exercise 2: Determining the sweet spot for the tank on which he is the Gunner.

Exercise 3: Tracking targets when the tank is moving.

Exercise 4: Lasing and firing on targets when the tank is moving.

Exercise 5: Reengaging to adjust fire.

The exercises build on each other by requiring the soldier to do the preceding exercise (or use the information from it, i.e., the sweet spot) as part of the exercise he is doing. For example, during Exercise 3, the soldier takes up the correct position in the Gunner's seat and tells the Driver to move out slowly in the direction of the target and increase his speed until the tank's sweet spot is achieved. Then he practices the components regarding tracking targets. The exercises are presented in Appendix C.

SUMMARY

A training program to provide elementary skill in M60A3 stabilized gunnery was developed. The program, centered around 14 analytically-derived principles of stabilized gunnery, is in three parts. The first, a knowledge videotape, familiarizes soldiers with "patterns" of reticle movement and demonstrates the correct point in the "pattern" to lase and fire. The second product, a practice videotape, when used with a mock-up of the Gunner's periscope and control handles, provides practice in "anticipating" the reticle movement, as well as in lasing and firing. The third product, a series of tank stabilized gunnery exercises, allows soldiers to practice on M60A3 tanks some of the things presented in the knowledge videotape and practiced using the practice tape device.

The three products of the training program development appear to be useful at the OSUT level. The knowledge videotape can be group administered using equipment available in any OSUT battalion. The gunner response device is relatively inexpensive to produce and can be set up in a dayroom or corner of a classroom. The M60A3 tank stabilized exercises can be practiced anytime a soldier is in the Gunner's seat and the tank is moving, say from the motor pool to the firing range or driving course.

A description of the development and evaluation of the training products is presented in the final report for the project (Harris *et al.*, 1982).

REFERENCES

- Author. Armor Weapon System Employment Parameters: Moving Platform Gunnery Training Techniques. Interim Report: Task 4 and Task 6. Human Resources Research Organization, Fort Knox, Kentucky, January 1981.
- Harris, J.H., Melching, W.H., Morrison, J.E., and Goldberg, S.L. Development and Evaluation of a Stabilized Gunnery Training Program. Human Resources Research Organization, Fort Knox, Kentucky, February 1982.
- Orgorkiewicz, R.M. "Tank Fire and Gun Control Systems," in International Defense Review, Volume 9, Number 1, 1976.
- U.S. Army. FM 17-12, Tank Gunnery. March 1977.
- U.S. Army. FM 17-12-3, Tank Gunnery for M60A3 Tank (Draft). Undated.
- U.S. Army. TM 9-2350-253-10, Operator's Manual, Tank, Combat, Full-Tracked: 105-MM Gun, M60A3. March 1979.

APPENDIX A
ADDITIONAL BIBLIOGRAPHIC ANNOTATIONS
ON STABILIZED GUNNERY

REPRODUCED PAGE BLANK-NOT FILMED

Richard, Bellows, Henry and Co. "Studies of Naval Air Basic Training: Fixed Gunnery Phase." New York, 1967, AD660029.

This report discusses the results of studies made concerning "Naval Air Basic Training: Fixed Gunnery Phase." Section A presents the rating sheet used to determine rank or difficulty for the problems identified. In Section B the results of the Problem Rating Sheet indicate that instructors' and students' ratings differ significantly. Section C deals with the standards for grading students on Fixed Gunnery performance. The Standards are instructor ratings, percent of hits of round fired and error rates. Section D represents the example of the effect of wind on Fixed Gunnery runs.

Knauft, E.B. "Memorandum on the Use of the Correct Point-of-Aim in Gunnery Training Devices." Iowa State University, Iowa City, Iowa, October 1946, AD639278.

This memorandum provides information and suggestions for the use of the correct point-of-aim in training devices. The possible methods in which point-of-aim may be used are also discussed. Tentative conclusions and recommendations of the "Methods" discussion are as follows:

1. Gunners should be trained on a large number of different attacks in a given sector.
2. The point of aim should be continuously visible to the gunner at the first presentation.
3. One method cannot be recommended over another due to insufficient evidence and experience.
4. No evidence is available concerning the amount of learning occurring when the point-of-aim is never visible to the gunner.

Knauft, E.B. "Memorandum on Progress of Learning Study on Aerial Gunnery Training Device 3-A-2." Iowa State University, Iowa City, Iowa, October 1946, AD639277.

The memorandum briefly summarizes research conducted as of October 1946 on the nature and extent of the learning process involved in the mastery of the aerial gunnery training device 3-A-2. The results of a preliminary experiment showed progressive group improvement for the duration of the experiment and that the ceiling of performance had not been reached.

Knauft, E.B. "An Experimental Study of Learning on the Aerial Gunnery Training Device 3-A-2." Iowa State University, Iowa City, Iowa, April 1947, AD639279.

This report describes the procedure and results of an investigation of the nature and extent of the learning process involved in the mastery of aerial gunnery training device 3-A-2. Specifically, the report discusses (1) the limit of skill attainable, (2) the amount of practice required to reach this limit, and (3) the form of the learning curve.

Two experiments were conducted using graduate students from the State University of Iowa. Equipment used included projectors, films, screen and a 3-A-2.

The students fired several practice and test rounds during seventeen (17) sessions. The first experiment showed that the students did not reach a ceiling of performance.

The second experiment was conducted under similar conditions. The results were that the group reached a maximum level of performance after 25-30 practice sessions; the average maximum score ranged from 50 to 55 percent hits and the learning curve resembled the ogive curve.

Knauft, E.B. "An Experimental Study of the Effectiveness of Various Training Procedures Used With the Aerial Gunnery Training Devices 3-A-35 and 3-A-2." Iowa State University, Iowa City, Iowa, July 1946, AD639275.

This report discusses an experiment conducted to determine the effectiveness of various training methods employed with the 3-A-35 device. The experiment also addressed the mechanical defects of the experiment.

The five different experimental training and conditions were:

1. Standard 3-A-35 (Tracking targets through 100° azimuth) - four sessions.
2. a) Tracking through 100° with point-of-aim visible on screen - two sessions.
b) Tracking and leading through 100° (3-A-35) - two sessions.
3. 3-A-2 condition (small azimuth movement) - four sessions.

4. a) Combination 3-A-2 (first two sessions).

b) 3-A-35 (last two sessions).

5. 3-A-35 with "On target" lights mounted on the turret yoke. The correct point-of-arm was not visible.

The analysis of the data indicated that none of the five training methods was significantly more efficient than any of the others. The subjects preferred the 3-A-35 because it was more realistic.

Recommendations were made concerning the improvement of the equipment used.

"Gunnery Training for Tank Crews." Foreign Science and Technology Center, U.S. Army Material Command, Dept. of the Army, November 1970.

The author (unknown) proposes a gunnery training program for tank crews designed to emphasize his opinion that precision is more important than rapidity. Described are the pertinent responsibilities of each crew member, simulated gunnery target ranges and exercises. The exercises include the use of subcaliber ammunition and simulators.

The author distinguishes between tanks with or without stabilizers to the extent of the differences in vulnerability time. The author does not discuss training for stabilized tanks. The effectiveness of any training, the author contends, is dependent upon the actual and maximum use of available resources.

APPENDIX B

SCRIPT FOR MOVING PLATFORM GUNNERY KNOWLEDGE VIDEOTAPE

M60A3 STABILIZED GUNNERY

Script for Moving Platform Gunnery Knowledge Videotape

SUPERIMPOSE

Wide view of M60A3 tank.

Close-up M60A3 tank moving with gun maintaining fixed orientation in space.

1. Press head firmly against browpad.
2. Press back against seat backrest.
3. Feet flat on turret floor directly below Gunner's control handles.

Close-up view of periscope reticle superimposed on target when both the firing tank and target are stationary.

Close-up view of periscope reticle superimposed on target when firing tank is moving and target is stationary.

NARRATION

AS YOU KNOW, THE STABILIZATION SYSTEM ON THE M60A3 TANK MAKES IT POSSIBLE TO ACQUIRE TARGETS AND TO FIRE ACCURATELY ON THE MOVE. THE STABILIZATION SYSTEM IS DESIGNED TO KEEP THE GUN ORIENTED ON THE SAME POINT IN ELEVATION AND DEFLECTION REGARDLESS OF THE UP-AND-DOWN OR SIDE-TO-SIDE MOTION OF THE TANK.

THE PURPOSE OF THIS VIDEOTAPE IS TO TELL AND SHOW YOU SOME THINGS ABOUT LASING AND FIRING AN M60A3 TANK FROM THE GUNNER'S POSITION WHEN THE TANK IS MOVING. LET'S BEGIN WITH POSITIONING YOURSELF IN THE TANK. YOU ALREADY KNOW, FROM YOUR EARLIER PRACTICE FIRING WHEN THE TANK IS STATIONARY, THAT YOU MUST TAKE UP A POSITION THAT IS COMFORTABLE FOR YOU. WHEN FIRING FROM A MOVING TANK, KEEP IN MIND THREE CONTACT POINTS WHEN TAKING UP YOUR POSITION. PRESS YOUR HEAD FIRMLY AGAINST THE GUNNER'S PERISCOPE BROWPAD AND PRESS YOUR LOWER BACK AGAINST THE GUNNER'S SEAT BACKREST. PLACE YOUR FEET FLAT ON THE FLOOR AND DIRECTLY BELOW THE CONTROL HANDLES. BOTH THE DRIVER AND THE TANK COMMANDER WILL KEEP YOU CONSTANTLY INFORMED REGARDING CHANGES IN TERRAIN, OR SPEED, OR BOTH, SO YOU CAN PREPARE FOR ANY CHANGES IN TANK MOTION. REMEMBER, WHEN YOU FIND THE POSITION THAT IS MOST COMFORTABLE FOR YOU, TAKE UP THAT SAME POSITION EVERY TIME YOU ARE A GUNNER.

BY WAY OF REVIEW, HERE IS WHAT THE SIGHT PICTURE AND PERISCOPE RETICLE LOOK LIKE WHEN THE FIRING TANK IS STATIONARY AND THE TARGET IS STATIONARY. NOTICE HOW STEADY THE RETICLE IS. NOW LET'S TALK ABOUT WHAT THE SIGHT PICTURE AND PERISCOPE RETICLE LOOK LIKE WHEN THE FIRING TANK IS MOVING AND THE STABILIZATION SYSTEM IS FULLY OPERATIONAL. NOTICE THAT THE RETICLE IS MOVING AROUND THE TARGET AREA. THE MOVEMENT HAS A PATTERN OR SAMENESS TO IT THAT YOU SHOULD BE ABLE TO SEE. WATCH IT FOR A FEW MOMENTS UNTIL THE PATTERN BECOMES CLEAR TO YOU. THE MOVEMENT IS CAUSED BY

SUPERIMPOSE

NARRATION

THE STABILIZATION SYSTEM OPERATING TO KEEP THE GUN ORIENTED ON THE TARGET AS LONG AS YOU CONTINUE TO TRACK. THE SPEED OF YOUR TANK AND THE TYPE OF TERRAIN WILL INFLUENCE THE RETICLE MOVEMENT. AT CERTAIN SPEEDS THE VIBRATION IN YOUR SIGHT PICTURE WILL BEGIN TO SMOOTH OUT AND THE RETICLE WILL JUMP AROUND LESS. THESE SPEEDS ARE CALLED SWEET SPOTS. DUE TO THE DIFFERENCES BETWEEN INDIVIDUAL TANKS, YOU SHOULD EXPERIMENT OVER DIFFERENT TYPES OF ROADS AND TERRAIN AT VARIOUS SPEEDS TO DETERMINE THE SWEET SPOT FOR YOUR TANK.

Close-up view of periscope reticle superimposed on target when both firing tank and target are stationary.

WHEN OPERATING IN THE STABILIZED MODE, YOU WILL NOT HAVE A STEADY SIGHT PICTURE LIKE YOU SEE WHEN THE FIRING TANK IS STATIONARY. DURING THE NEXT PART OF THE VIDEOTAPE YOU WILL SEE WHAT THE SIGHT PICTURE AND PERISCOPE RETICLE LOOK LIKE UNDER SPECIFIC FIRING TANK AND TARGET SITUATIONS. FOLLOWING THOSE PRESENTATIONS, YOU WILL SEE WHERE, DURING THE MOVEMENT OF THE RETICLE AROUND THE TARGET AREA, YOU SHOULD LAZE AND FIRE.

SUPERIMPOSE

NARRATION

SITUATION 1

- Firing tank speed: 5mph.
- Terrain: Smooth.
- Target speed: Stationary.
- Target direction: Facing.
- Firing tank to target range: 1400 meters.

IN THE FIRST SITUATION, THE FIRING TANK IS TRAVELING 5 MILES PER HOUR ON SMOOTH TERRAIN. THE TARGET IS STATIONARY FACING THE FIRING TANK AT A RANGE OF 1400 METERS.

WHEN FIRING ON THE MOVE, YOU WILL HAVE A NATURAL TENDENCY TO USE THE GUNNER'S CONTROL HANDLES TO TRY TO MAKE THE PERISCOPE RETICLE LAY MOTIONLESS ON THE CENTER OF MASS. DO NOT TRY TO MAKE THESE FINE CORRECTIONS AROUND THE TARGET AREA. LET THE STABILIZATION SYSTEM DO THAT FOR YOU. USE YOUR CONTROL HANDLES TO TRACK THE TARGET.

SITUATION 2

- Firing tank speed: 5mph.
- Terrain: Smooth.
- Target speed: Stationary.
- Target direction: Facing.
- Firing tank to target range: 1600 meters.

THIS SECOND SITUATION IS IDENTICAL TO THE FIRST EXCEPT THAT THE FIRING TANK TO TARGET RANGE HAS BEEN INCREASED TO 1600 METERS. THE FIRING TANK IS TRAVELING 5 MILES PER HOUR ON SMOOTH TERRAIN. THE TARGET IS STATIONARY FACING THE FIRING TANK AT A RANGE OF 1600 METERS.

YOU SHOULD LAZE AND FIRE ONLY WHEN THE GUN TUBE IS OVER THE FRONT DECK. AN EXCEPTION CAN BE MADE WHEN YOU ENCOUNTER A SURPRISE TARGET ON YOUR FLANK.

SITUATION 3 (HORIZONTAL SPLIT)

- Firing tank speed: 5mph.
 - Terrain: Smooth.
 - Target speed: Stationary.
 - Target direction: Facing.
 - Firing tank to target range: 1400 meters.
-
- Firing tank speed: 5mph.
 - Terrain: Smooth.
 - Target speed: Stationary.
 - Target direction: Facing.
 - Firing tank to target range: 1600 meters.
- Superimpose { Firing tank to target range: 1400 meters.
- { Firing tank to target range: 1600 meters.

NOW, LET'S LOOK AT THE FIRST TWO SITUATIONS AT THE SAME TIME. IN BOTH VIEWS, THE FIRING TANK IS TRAVELING 5 MILES PER HOUR ON SMOOTH TERRAIN. THE TARGET IS STATIONARY FACING THE FIRING TANK. THE FIRING TANK TO TARGET RANGE IS 1400 METERS FOR THE SITUATION ON THE TOP OF THE SCREEN AND 1600 METERS FOR THE SITUATION ON THE BOTTOM OF THE SCREEN.

SUPERIMPOSE

NARRATION

SITUATION 4

- Firing tank speed: 5mph.
- Terrain: Smooth.
- Target speed: 10mph.
- Target direction: Right to left.
- Firing tank to target range: 1600 meters.

DURING THIS NEXT SITUATION, THE FIRING TANK IS AGAIN TRAVELING 5 MILES PER HOUR ON SMOOTH TERRAIN. NOW, HOWEVER, THE TARGET IS ALSO TRAVELING. IN THIS CASE, FROM RIGHT TO LEFT AT 10 MILES PER HOUR AT A RANGE OF 1600 METERS.

SITUATION 5

- Firing tank speed: 5mph.
- Terrain: Rough.
- Target speed: 10mph.
- Target direction: Left to right.
- Firing tank to target range: 1000-500 meters.

THE FIRING TANK SPEED REMAINS AT 5 MILES PER HOUR. THE TERRAIN OVER WHICH THE FIRING TANK TRAVELS IS ROUGH INSTEAD OF SMOOTH. THE TARGET IS MOVING FROM LEFT TO RIGHT AT 10 MILES PER HOUR AT A RANGE WHICH BEGINS AT 1000 METERS AND DECREASES TO 500 METERS.

REMEMBER, USE YOUR GUNNER'S CONTROL HANDLES TO TRACK THE TARGET. DO NOT TRY TO MAKE FINE CORRECTIONS AROUND THE TARGET AREA. LET THE STABILIZATION SYSTEM DO THAT FOR YOU.

SITUATION 6 (HORIZONTAL SPLIT)

- Firing tank speed: 5mph.
 - Terrain: Smooth.
 - Target speed: 10mph.
 - Target direction: Right to left.
 - Firing tank to target range: 1600 meters.
-
- Firing tank speed: 5mph.
 - Terrain: Rough.
 - Target speed: 10mph.
 - Target direction: Left to right.
 - Firing tank to target range: 1000-500 meters.

Superimpose { Terrain: Smooth
Terrain: Rough

COMPARE THE SIGHT PICTURE AND PERISCOPE RETICLE MOVEMENT WHEN THE TERRAIN IS SMOOTH (TOP OF THE SCREEN) WITH THE SIGHT PICTURE AND PERISCOPE RETICLE MOVEMENT WHEN THE TERRAIN IS ROUGH (BOTTOM OF THE SCREEN). REMEMBER, THE FIRING TANK SPEED IS 5 MILES PER HOUR AND THE TARGET SPEED IS 10 MILES PER HOUR.

SUPERIMPOSE

NARRATION

SITUATION 7

- Firing tank speed: 10mph.
- Terrain: Rough.
- Target speed: 10mph.
- Target direction: Right to left.
- Firing tank to target range: 1000-500 meters.

HERE, THE FIRING TANK SPEED INCREASES TO 10 MILES PER HOUR ON ROUGH TERRAIN. THE TARGET IS MOVING FROM RIGHT TO LEFT AT 10 MILES PER HOUR AT A RANGE WHICH BEGINS AT 1000 METERS AND DECREASES TO 500 METERS.

SITUATION 8 (HORIZONTAL SPLIT)

- Firing tank speed: 5mph.
- Terrain: Rough.
- Target speed: 10mph.
- Target direction: Left to right.
- Firing tank to target range: 1000-500 meters.
- Firing tank speed: 10mph.
- Terrain: Rough.
- Target speed: 10mph.
- Target direction: Right to left.
- Firing tank to target range: 1000-500 meters.

Superimpose

- Firing tank speed: 5mph.
- Firing tank speed: 10mph.

IN THE NEXT SITUATION, COMPARE THE SIGHT PICTURE AND PERISCOPE RETICLE MOVEMENT WHEN THE FIRING TANK IS MOVING 5 MILES PER HOUR ON ROUGH TERRAIN (AT THE TOP OF THE SCREEN) WITH THE SIGHT PICTURE AND PERISCOPE RETICLE MOVEMENT WHEN THE TANK IS MOVING 10 MILES PER HOUR ON ROUGH TERRAIN (AT THE BOTTOM OF THE SCREEN). THE TARGET SPEED IN BOTH CASES IS 10 MILES PER HOUR AND THE RANGE DECREASES FROM 1000-500 METERS.

NOTICE THAT THE SIGHT PICTURE AND PERISCOPE RETICLE AT 10 MILES PER HOUR IS NOT SMOOTHER THAN THE PICTURE AT 5 MILES PER HOUR. THIS IS BECAUSE THE TANKS ARE ON ROUGH TERRAIN WHERE THE SWEET SPOT TENDS TO OCCUR AT SLOWER SPEEDS. THIS IS AN EXAMPLE OF THE EFFECT OF TERRAIN AND SPEED ON A TANK'S SWEET SPOT.

SITUATION 9

- Firing tank speed: 5mph.
- Terrain: Rough.
- Target speed: 10mph.
- Target direction: Right to left.
- Firing tank to target range: 1200-500 meters.

DURING THIS SITUATION, YOU WILL HEAR THE TANK COMMANDER ISSUE A FIRE COMMAND AND SEE THE GUN LAID FOR DIRECTION. YOU WILL HEAR THE GUNNER ANNOUNCE "IDENTIFIED" AS YOU SEE THE TARGET ENTER HIS FIELD OF VIEW AND YOU WILL SEE THE EFFECTS ON THE SIGHT PICTURE OF SMOKE, DUST, AND OTHER DEBRIS. THE FIRING TANK IS MOVING 5 MILES PER HOUR ON ROUGH TERRAIN. THE TARGET IS MOVING FROM RIGHT TO LEFT AT 10 MILES PER HOUR AT A RANGE WHICH BEGINS AT 1200 METERS

SUPERIMPOSE

NARRATION

AND DECREASES TO 500 METERS.

SAY: GUNNER HEAT TANK

SAY: IDENTIFIED

REMEMBER, USE YOUR GUNNER'S CONTROL HANDLES TO TRACK THE TARGET. DO NOT TRY TO MAKE FINE CORRECTIONS AROUND THE TARGET AREA. LET THE STABILIZATION SYSTEM DO THAT FOR YOU.

SITUATION 10

- Firing tank speed: 10mph.
- Terrain: Rough.
- Target speed: 10mph.
- Target direction: Advancing.
- Firing tank to target range: 1000-500 meters.

AGAIN, YOU WILL HEAR A FIRE COMMAND, SEE THE GUN LAID FOR DIRECTION AND HEAR "IDENTIFIED." THE FIRING TANK IS MOVING 10 MILES PER HOUR ON ROUGH TERRAIN. THE TARGET IS ADVANCING ON THE FIRING TANK AT 10 MILES PER HOUR AT A RANGE WHICH DECREASES FROM 1000-500 METERS.

SAY: GUNNER HEAT TANK

SAY: IDENTIFIED

SITUATION 11

- Firing tank speed: 5-7mph.
- Terrain: Rough.
- Target speed: 10mph.
- Target direction: Retreating.
- Firing tank to target range: 700-500 meters.

DURING THIS SITUATION, THE FIRING TANK SPEED WILL INCREASE FROM 5 TO 7 MILES PER HOUR AS THE TANK TRAVELS OVER ROUGH TERRAIN IN PURSUIT OF A TARGET RETREATING AT 10 MILES PER HOUR. THE RANGE TO THE TARGET WILL DECREASE FROM 700 TO 500 METERS. ALSO, YOU WILL HEAR A FIRE COMMAND, SEE THE GUN LAID FOR DIRECTION, AND HEAR "IDENTIFIED."

SAY: GUNNER HEAT TANK

SAY: IDENTIFIED

SITUATION 12

- Firing tank speed: 20mph.
- Terrain: Smooth.
- Target speed: Stationary.
- Target direction: Side.
- Firing tank to target range: 1100 meters.

REMEMBER WHAT WAS SAID EARLIER ABOUT THE SPEED OF THE TANK AND THE TYPE OF TERRAIN INFLUENCING THE RETICLE MOVEMENT? WE SAID THAT, AS A GENERAL RULE, THE FASTER THE FIRING TANK TRAVELS, THE SMOOTHER THE RETICLE MOVEMENT BECOMES. WATCH DURING THIS SITUATION AS THE FIRING TANK PROGRESSES FROM 5 MILES PER HOUR TO 20 MILES PER HOUR. YOU WILL NOTICE THE RETICLE MOVEMENT BECOME MORE UNIFORM AND SMOOTH, AND, EVEN THOUGH THE TARGET APPEARS OUT OF FOCUS, THE STABILIZATION SYSTEM AND THE GUNNER ARE ABLE TO KEEP THE GUN ORIENTED ON THE TARGET. THE FIRING TANK IS MOVING 20 MILES PER HOUR ON SMOOTH TERRAIN. THE TARGET IS STATIONARY FACING LEFT TO RIGHT AT A RANGE OF 1100 METERS.

NARRATION

NOW THAT YOU HAVE SEEN WHAT THE SIGHT PICTURE AND PERISCOPE RETICLE LOOK LIKE UNDER SPECIFIC FIRING TANK AND TARGET SITUATIONS, LET'S SEE WHERE, DURING THE MOVEMENT OF THE RETICLE AROUND THE TARGET AREA, YOU SHOULD LASE AND FIRE. WHEN ENGAGING TARGETS FROM A MOVING TANK, YOU WILL NOT HAVE A PERFECT SIGHT PICTURE. THE RETICLE WILL BE MOVING AROUND THE TARGET AREA. YOU MUST ANTICIPATE WHEN THE RETICLE WILL MOVE TOWARD THE CENTER OF MASS AND LASE AND FIRE IMMEDIATELY WHEN IT STARTS TO MOVE TOWARDS THE CENTER OF MASS OF THE TARGET. THE MOST IMPORTANT THING TO REMEMBER IS TO LASE AND THEN FIRE IMMEDIATELY AS THE RETICLE MOVES TOWARD THE CENTER OF MASS OF THE TARGET. TO LASE AND FIRE, DEPRESS AND HOLD EITHER PALM SWITCH. TRACK THE TARGET FOR AT LEAST 1-1/2 SECONDS AND DEPRESS AND RELEASE EITHER GUNNER'S THUMB SWITCH TO SET LEAD AND FIRE LASER. TO CANCEL LEAD, RELEASE PALM SWITCH. WATCH THE FOLLOWING SITUATIONS TO SEE WHERE TO LASE AND FIRE.

SUPERIMPOSE

NARRATION

SITUATION 13

Sight picture freezes at the time
of each word.

LASE.
FIRE.

SITUATION 14

Sight picture freezes at the time
of each word.

LASE.
FIRE.

SITUATION 15

Sight picture freezes at the time
of each word.

LASE.
FIRE.

REMEMBER: ANTICIPATE WHEN THE RETICLE
WILL MOVE TOWARD THE CENTER OF MASS AND
LASE AND FIRE IMMEDIATELY WHEN IT DOES.

SITUATION 16

BECAUSE OF THE SPEED AND ACCURACY OF THE
LASER RANGEFINDER AND BALLISTIC COMPUTER,
THE BEST METHOD TO ADJUST FIRE IS TO USE
THE REENGAGE TECHNIQUE WHERE YOU TREAT
EVERY ROUND AS A SEPERATE ENGAGEMENT.
AFTER FIRING A ROUND THAT DOES NOT HIT
THE TARGET RELEASE AND THEN DEPRESS
GUNNER'S PALM SWITCH, TRACK TARGET, RELEASE
AND SET LEAD, AND FIRE A SECOND ROUND.

Sight picture freezes at sound
of each word.

LASE.
FIRE.
RELEASE.
FIRE.

SITUATION 17

Sight picture freezes at sound
of each word.

LASE.
FIRE.

OVERLAY

IF THE FIRST ROUND MISSES THE TARGET . . .
RELEASE.
FIRE.

SUPERIMPOSE

Three Contact Points

1. Press head firmly against browpad.
2. Press lower back against Gunner's seat backrest.
3. Place feet flat on turret floor.

Sweet Spot

1. The speed where vibration in sight picture smooths out and reticle jumps around less.

Tracking

1. Let stabilization system make fine corrections around the target area.
2. Use Gunner's control handles to track the target.

Front Deck

1. Lase and fire only when gun tube is over the front deck, unless
2. You encounter a surprise target on your flank.

NARRATION

LET'S REVIEW FOR A FEW MOMENTS SOME OF THE THINGS YOU LEARNED FROM THE VIDEOTAPE ABOUT LASING AND FIRING AN M60A3 TANK FROM THE GUNNER'S POSITION WHEN THE TANK IS MOVING. FIRST, KEEP IN MIND THREE CONTACT POINTS WHEN TAKING UP YOUR POSITION IN THE GUNNER'S SEAT. PRESS YOUR HEAD FIRMLY AGAINST THE GUNNER'S PERISCOPE BROWPAD AND PRESS YOUR LOWER BACK AGAINST THE GUNNER'S SEAT BACKREST. PLACE YOUR FEET FLAT ON THE FLOOR AND DIRECTLY BELOW THE CONTROL HANDLES.

SECOND, THE RETICLE MOVEMENT AROUND THE TARGET AREA IS CAUSED BY THE STABILIZATION SYSTEM OPERATING TO KEEP THE GUN ORIENTED ON THE TARGET AS LONG AS YOU CONTINUE TO TRACK. THE SPEED OF YOUR TANK AND THE TYPE OF TERRAIN WILL INFLUENCE THE RETICLE MOVEMENT. AT CERTAIN SPEEDS THE VIBRATION IN YOUR SIGHT PICTURE WILL BEGIN TO SMOOTH OUT AND THE RETICLE WILL JUMP AROUND LESS. THESE SPEEDS ARE CALLED SWEET SPOTS.

THIRD, WHEN FIRING ON THE MOVE, YOU WILL HAVE A NATURAL TENDENCY TO USE THE GUNNER'S CONTROL HANDLES TO TRY TO MAKE THE PERISCOPE RETICLE LAY MOTIONLESS ON THE CENTER OF MASS. DO NOT TRY TO MAKE THESE FINE CORRECTIONS AROUND THE TARGET AREA. LET THE STABILIZATION SYSTEM DO THAT FOR YOU. USE YOUR CONTROL HANDLES TO TRACK THE TARGET.

FOURTH, YOU SHOULD LASE AND FIRE ONLY WHEN THE GUN TUBE IS OVER THE FRONT DECK. AN EXCEPTION CAN BE MADE WHEN YOU ENCOUNTER A SURPRISE TARGET ON YOUR FLANK.

SUPERIMPOSE

NARRATION

Lase and Fire

1. Anticipate when reticle will move toward center of .
2. Lase and fire immediately when it moves toward center of mass.
3. Depress and hold either palm switch.
4. Track for at least 1-1/2 seconds.
5. Depress and release either Gunner's thumb switch.

FIFTH, YOU MUST ANTICIPATE WHEN THE RETICLE WILL MOVE TOWARD THE CENTER OF MASS AND LASE AND FIRE IMMEDIATELY WHEN IT STARTS TO MOVE TOWARDS THE CENTER MASS OF THE TARGET. TO LASE AND FIRE, DEPRESS AND HOLD EITHER PALM SWITCH, TRACK THE TARGET FOR AT LEAST 1-1/2 SECONDS AND DEPRESS AND RELEASE EITHER GUNNER'S THUMB SWITCH TO SET LEAD AND FIRE LASER.

Reengage

1. Reengage technique to adjust fire.
2. Release and then depress Gunner's palm switch.
3. Track target.
4. Relase.
5. Fire a second round.

SIXTH, BECAUSE OF THE SPEED AND ACCURACY OF THE LASER RANGEFINDER AND BALLISTIC COMPUTER, THE BEST TECHNIQUE TO ADJUST FIRE IS TO USE THE REENGAGE TECHNIQUE WHERE YOU TREAT EVERY ROUND AS A SEPARATE ENGAGEMENT. AFTER FIRING A ROUND THAT DOES NOT HIT THE TARGET, RELEASE AND THEN DEPRESS GUNNER'S PALM SWITCH, TRACK TARGET, RELASE AND SET LEAD, AND FIRE A SECOND ROUND.

APPENDIX C

M60A3 TANK STABILIZED GUNNERY EXERCISES

M60A3 TANK STABILIZED GUNNERY EXERCISES

The purpose of these exercises is to give the soldier an opportunity to practice some of the things he learned from the M60A3 stabilized gunnery knowledge and practice videotapes about lasing and firing the tank from the Gunner's position when the tank is moving. The exercises include:

1. Taking up the correct position in the Gunner's seat.
2. Determining the sweet spot for the tank on which he is the Gunner.
3. Tracking targets when the tank is moving.
4. Lasing and firing on targets when the tank is moving.
5. Reengaging to adjust fire.

These five exercises comprise the essential requirements for acquiring proficiency in moving platform gunnery on the M60A3 tank--they should be practiced whenever possible. The practice can be done formally, during scheduled training time; or informally, whenever the tank is moving and the soldier is in the Gunner's position. The Tank Commander is responsible for supervising the conduct of the exercises.

EXERCISE 1

Take Up Correct Position In Gunner's Seat

INTRODUCTION:

"To take up the correct position in the Gunner's seat, remember the three contact points:

1. Press your head firmly against the Gunner's periscope browpad.
2. Press your lower back against the Gunner's seat backrest.
3. Place your feet flat on the floor and directly below the control handles.

I will demonstrate the procedure to you; then you will perform the procedure."

PROCEDURE:

- a. Demonstrate the procedure by describing aloud each contact point as you "make contact". When you press your head firmly against the Gunner's periscope browpad, emphasize the importance of placing your head in the same position in the head rest each time. Point out, also, that the soldier should be aware of pressure points on the head and face which can serve as cues to correct positioning of the head.
- b. Tell soldier to get in the Gunner's seat and take up the correct position. See that his lower back is against the seat backrest and his feet are flat on the floor and directly below the control handles. Remind soldier to place his head in the same position in the head rest each time and to be aware of pressure points on the head and face which can serve as cues to correct positioning of head.
- c. Require soldier to practice taking up the correct position in the Gunner's seat until he can correctly:
 1. Place his head firmly against periscope browpad.
 2. Press his lower back against the seat backrest.
 3. Place his feet flat on the floor and directly below the control handles.

EXERCISE 2

Determine Sweet Spot

INTRODUCTION:

"The apparent reticle movement around the target area is caused by the stabilization system operating to keep the gun oriented on the target as long as you continue to track. The speed of your tank and the type of terrain will influence the reticle movement. At certain speeds the vibration in your sight picture will begin to smooth out and the reticle will appear to jump around less. These speeds are called sweet spots. During this exercise, you will learn how to determine the sweet spot for your tank. This is done by sighting through your primary sight onto a distant target over the front deck. Then, tell the Driver to move out slowly and increase his speed in 5 mile per hour increments, notifying you of each increment, until the tank speed reaches 25 miles per hour. Decide at which speed the vibration in the sight picture was least distracting and the reticle was "jumping around" least. This is the sweet spot for this tank on this type of terrain. Repeat the procedure to verify the sweet spot; then, repeat the exercise on another type of terrain. Take up the correct position in the Gunner's seat and determine the sweet spot for your tank."

PROCEDURE:

- a. Gunner takes up correct position in Gunner's seat and places the tank in the STAB mode.
- b. Gunner looks through his primary sight and selects a distant target over the front deck.
- c. Gunner tells Driver to move out slowly in the direction of the aiming point and increase his speed in 5 mile per hour increments.
- d. Gunner tells Driver to inform him of each 5 mile per hour increment until the tank speed reaches 25 miles per hour.
- e. Gunner maintains primary sight picture until tank reaches 25 miles per hour and decides at which announced speed the vibration in the sight picture was least distracting and the reticle was "jumping around" least.
- f. Gunner repeats steps b through e to verify the sweet spot.
- g. Gunner repeats the exercise on another type of terrain.
- h. Tank Commander requires Gunner to practice the exercise until the "sweet spot" verifies on each type of terrain.

EXERCISE 3

Track Targets

INTRODUCTION:

"When firing on the move, you will have a natural tendency to use the Gunner's control handles to try to make the periscope reticle lay motionless on the center of mass. Do not try to make these fine corrections around the target area. Let the stabilization system do that for you. Use your control handles to track the target. Use the same distant aiming point you used to determine the sweet spot and track that "target" as your tank moves toward it."

PROCEDURE:

- a. Gunner takes up correct position in Gunner's seat and places the tank in STAB mode.
- b. Gunner looks through his primary sight to sight on the target.
- c. Gunner tells Driver to move out slowly in the direction of the target and increase his speed until the tank's sweet spot speed is achieved.
- d. Gunner maintains primary sight picture by traversing turret left and right to track the target.
- e. Tank Commander views sight picture through his primary sight extension and provides feedback to the Gunner regarding his tracking response.
- f. Tank Commander requires Gunner to practice the exercise until he can track the target in direction while letting the stabilization system make fine corrections.

EXERCISE 4

Lase and Fire on Targets

INTRODUCTION:

"When engaging targets, you must anticipate when the reticle will move toward the center of mass and lase and fire immediately when it starts to move toward the center of mass of the target. To lase and fire, depress and hold either palm switch, track the target for at least 1-1/2 seconds, and depress and release either Gunner's thumb switch to set lead and fire laser. Then press either firing trigger to fire the round. We'll use the same target we used during the tracking exercise; this time, you engage the target. Be sure to announce LASE when you set the lead and fire the laser, and ON THE WAY when you fire the round.

NOTE

Laser safety as outlined in AR 385-22 should be observed.

PROCEDURE:

- a. Gunner takes up correct position in Gunner's seat and places the tank in STAB mode.
- b. Gunner looks through his primary sight to sight on the target.
- c. Gunner tells Driver to move out slowly in the direction of the target and increase his speed until the tank's sweet spot speed is achieved.
- d. Gunner maintains primary sight picture by traversing turret left and right to track the target.
- e. Tank Commander views sight picture through his primary sight extension and provides feedback to the Gunner regarding his tracking response.
- f. Gunner depresses and holds either palm switch and tracks target for at least 1-1/2 seconds.
- g. Gunner announces LASE and depresses and releases either thumb switch as reticle appears to move toward the center of mass of the target.
- h. Tank Commander views sight picture through his primary sight extension and provides feedback to the Gunner regarding his lasing response.

- i. Gunner announces ON THE WAY and fires as the reticle appears to move again toward the center of mass of the target.
- j. Tank Commander views sight picture through his primary sight extension and provides feedback to the Gunner regarding his firing response.
- k. Tank Commander requires Gunner to practice the exercise until he can lose and fire reliably.

NOTE: The Tank Commander may want to vary the exercise by including fire commands, changing targets, or changing the terrain over which the firing tank travels. Anything he chooses to do is acceptable as long as the firing tank is moving and the Gunner is required to perform the prescribed procedure.

EXERCISE 5

Reengage Targets

INTRODUCTION:

"Because of the speed and accuracy of the laser rangefinder and ballistic computer, the best technique to adjust fire is to use the reengage technique where you treat every round as a separate engagement. After firing a round that does not hit the target, release and then depress the Gunner's palm switch, track target, release and set lead, and fire a second round. During this exercise you will engage a target and then respond to my sensings. Be sure to announce LASE whenever you set the lead and fire the laser, and ON THE WAY whenever you fire a round. Prepare to move out."

NOTE

Laser safety as outlined
in AR 385-22 should be
observed.

PROCEDURE:

- a. Gunner takes up correct position in Gunner's seat and places the tank in STAB mode.
- b. Tank Commander tells Driver to move out.
- c. Tank Commander issues fire command and lays gun for direction.
- d. Gunner looks through his unity window and announces IDENTIFIED when he sees the target.
- e. Gunner looks through his primary sight to sight on the target.
- f. Gunner tells Driver to increase his speed until the tank's sweet spot is achieved.
- g. Gunner maintains primary sight picture by traversing turret left and right to track the target.
- h. Tank Commander views sight picture through his primary sight extension and provides feedback to the Gunner regarding his tracking response.
- i. Gunner depresses and holds either palm switch and tracks target for at least 1-1/2 seconds.
- j. Gunner announces LASE and depresses and releases either thumb switch as reticle appears to move toward the center of mass of the target.

- k. Tank Commander views sight picture through his primary sight extension and provides feedback to the Gunner regarding his lasing response.
- l. Gunner announces ON THE WAY and fires as the reticle moves again toward the center of mass of the target.
- m. Tank Commander views sight picture through his primary sight extension and provides feedback to the Gunner regarding his firing response.
- n. Tank Commander announces REENGAGE.
- o. Gunner releases palm switches momentarily, depresses and holds either palm switch, and tracks target for at least 1-1/2 seconds.
- p. Gunner announces LASE and depresses and releases either thumb switch as reticle appears to move toward the center of mass of the target.
- q. Tank Commander views sight picture through his primary sight extension and provides feedback to the Gunner regarding his lasing response.
- r. Gunner announces ON THE WAY and fires as the reticle appears to move again toward the center of mass of the target.
- s. Tank Commander views sight picture through his primary sight extension and provides feedback to the Gunner regarding his firing response.
- t. Tank Commander requires Gunner to practice the exercise until he can lase and fire as the reticle appears to move toward the center of mass of the target; and, until he can adjust fire by using the reengage technique.

NOTE: The Tank Commander may want to vary the exercise by changing fire commands, changing targets, or changing the terrain over which the firing tank travels. Anything he chooses to do is acceptable as long as the firing tank is moving and the Gunner is required to perform the prescribed procedure.